CLAIMS

1. A diagnostic method, comprising:

assessing mitochondrial status in a maternal sample, wherein a mitochondrial deletion associated with altered metabolic activity is predictive of a pre-disposition to a chromosomal abnormality associated with Down Syndrome in a fetus.

2. A diagnostic method, comprising:

assessing mitochondrial status in a maternal sample, wherein a level of mitochondrial membrane potential that is less than a normal baseline value of mitochondrial membrane potential is predictive of a pre-disposition to a chromosomal abnormality associated with Down Syndrome in a fetus.

3. The method of claim 1 or 2, wherein the maternal sample is peripheral blood.

4. The method of claim 1 or 2, wherein the maternal sample is isolated from a subject prior to assessment of mitochondrial status.

5. The method of claim 1 or 2, wherein the diagnostic method is performed on a subject prior to conception.

6. The method of claim 1 or 2 wherein the diagnostic method is performed on a subject after conception.

7. The method of claim 6, further comprising performing amniocentesis after assessing the mitochondrial status.

8. The method of claim 2, wherein the mitochondrial status is determined by a quantitative measure of electron potential.

9. The method of claim 8, wherein the quantitative measure is performed using mitotracker red.

10. The method of claim 2, wherein the mitochondrial status is determined by a detection of cell surface molecule expression.

11. The method of claim 10, wherein the cell surface molecule is selected from the group consisting of MHC class I, MHC class II, fas, B71, B72, CD40, fas ligand, and cell surface UCP.

12. The method of claim 1, wherein the mitochondrial deletion is a deletion in complex I genes of mitochondrial DNA.

13. A method of modifying an oocyte or embryonic cell, comprising:

microinjecting a heterologous mitochondria into an oocyte or embryonic cell wherein the heterologous mitochondria is capable of achieving at least normal levels of mitochondrial membrane potential in the oocyte or embryonic cell.

14. The method of claim 13, wherein the heterologous mitochondria is microinjected in vitro and the oocyte or embryonic cell is then implanted into a subject.

15. The method of claim 13, wherein the oocyte is derived from a subject determined to have a pre-disposition to a chromosomal abnormality associated with Down Syndrome in a fetus.

16. A modified stem cell, comprising a stem cell having a heterologous mitochondria.

17. The modified stem cell of claim 16 wherein the heterologous mitochondria has a level of mitochondrial membrane potential that is within a normal range relative to a healthy stem cell.

18. A method for promoting tissue generation, comprising subjecting the modified stem cell of claim 14 to growth promoting conditions.

19. The method of claim 18, wherein the modified stem cell is implanted into a subject.

20. The method of claim 19 wherein the modified stem cell is autologous to the subject.

21. The method of claim 18, wherein the stem cell is a neural stem cell.

22. A screening assay, comprising:

obtaining a biological sample from a subject associated with Down Syndrome, and

identifying mitochondrial deletion that is present in the biological sample but not in a normal biological sample, wherein the mitochondrial deletion is predictive of Down Syndrome in a fetus of the subject associated with Down Syndrome.

23. The screening assay of claim 22, wherein the subject associated with Down Syndrome is a subject who has carried a fetus known to have a chromosomal abnormality associated with Down Syndrome.

24. The screening assay of claim 22, wherein the mitochondrial deletion is identified using a subtractive hybridization assay.

25. A kit for assessing mitochondrial status in a maternal sample, comprising a reagent for detecting a mitochondrial deletion associated with altered metabolic activity, and instructions for utilizing the reagent to identify the deletion as a predictor of a pre-disposition to a chromosomal abnormality associated with Down Syndrome in a fetus.

26. The kit of claim 25, further comprising a collection device for collecting a sample of peripheral blood.

27. The kit of claim 25, wherein the reagent is a nucleic acid probe.

28. The kit of claim 27, further comprising a labeling system for labeling the nucleic acid probe.

29. A kit for assessing mitochondrial status in a maternal sample, comprising a reagent for detecting a level of mitochondrial membrane potential and instructions for utilizing the reagent to identify the level of mitochondrial membrane potential as a predictor of a pre-disposition to a chromosomal abnormality associated with Down Syndrome in a fetus.

30. The kit of claim 29, wherein the reagent is mitotracker dye.

31. A neural stem cell having an isolated UCP4 gene under the control of a promoter.

32. The neural stem cell of claim 31, further comprising an isolated UCP2 gene under the control of a promoter.

33. A neural stem cell having an isolated UCP2 gene under the control of a promoter.

34. The neural stem cell of claim 33, further comprising an isolated UCP4 gene under the control of a promoter.

35. The neural stem cell of any one of claims 31-34 wherein the promoter is an inducible promoter.

36. A method of generating neural tissue comprising implanting a neural stem cell of claim 32 into a subject, inducing expression of the UCP2 gene to grow neural tissue, and inducing expression of the UCP4 gene to differentiate the neural stem cells into neural tissue.

37. A modified oocyte or embryonic cell, comprising:
an oocyte or embryonic cell having a microinjected heterologous mitochondria.

38. The method of claim 13, wherein the mitochondria has a deletion.